Estimating land-clearing costs using aerial photography

Aerial color and infrared-color photography can be used to determine elevations and extent of various types of vegetation in land to be cleared. A case history illustrates use of the method, and documents potential savings.

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At the Palmer Brook site at Becket, Massachusetts, a dam will be built at one end of a river valley to form a lake about 6,000 ft long. The engineer retained for this project, Robert G. Brown & Associates, Inc., calculated the new height of the water level after construction of the proposed dam and then surveyed a flood pool map for the site. Some 150 acres of land were enclosed within the flood pool and would therefore have to be cleared.

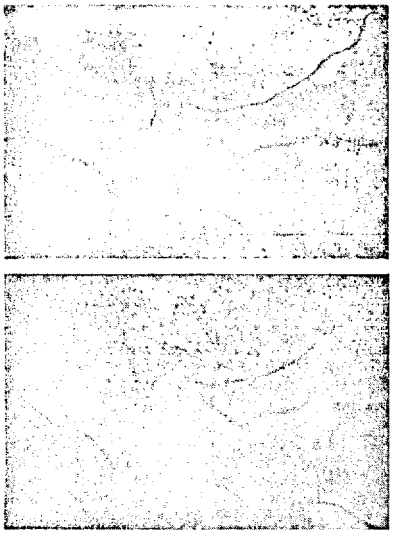
A cursory examination of the site on foot showed that there were several distinct vegetation types that needed clearing, e.g., extensive swamp, evergreen thickets, stands of deciduous trees and mixed evergreen-deciduous stands. Each vegetation province would pose different problems (and costs) to the land clearing contractor.

From past experience it was known that some land clearing contractors bidding on this job would assume for budget purposes that the entire 150 acres was swamp, and assign to the project the higher costs associated with swamp clearing. This extensive markup on land clearing jobs is apparently common to many land clearing contractors throughout the country, and is not so much a question of obtaining greater profits for the contractors, but rather to insure themselves against any possible contingencies. This matter was discussed at great length at the Land Development Seminar, June 1967, conducted by Caterpillar [illegible] quarters in Peoria, Ill. It was agreed there that few land clearing contractors have adequate data on the terrain involved to make realistic estimates for bidding purposes. The spread in bid prices on the Palmer Brook job certainly confirms this fact.

Aerial photos help in estimating?

As an experiment, the Development and Resources Transportation Co. (D&RT Co.) in cooperation with the engineering firm of Robert G. Brown & Associates, Inc., attempted to determine by means of large-scale color and Ektachrome Infrared aerial photography what value would accrue to the contracting agency if detailed data as to number of acres of each type of vegetation were provided to all clearing contractors bidding on the Palmer Brook job. The color aerial photography approach was suggested by work of a similar nature that D&RT Co. had done earlier in jungle areas of Colombia and Peru. (In those instances, the D&RT Co. had taken color and Ektachrome Infrared aerial photography of two large-scale pilot agricultural land clearing project sites prior to clearing by Caterpillar D-8H tractors with Rome KG blades. During the clearing operations, D&RT Co. had a tropical botanist and engineer on the ground monitoring the operation so that these data could be correlated and cost of land clearing in similar areas could be estimated by means of aerial photography only.) At these locations a definite relation was established between cost of land clearing and vegetation [illegible] ties as seen with color and especially Ektachrome Infrared aerial photography. Accordingly, it was felt that the same approach might have merit at the Palmer Brook site.

Standard U.S. Department of Agriculture aerial photography already existed for this area. It was in black and white at a scale of 1:20,000. On this scale, and with only the range of contrasts available to black and white photography, the Palmer Brook site appeared essentially an unvarying gray throughout. However, when D&RT Co. took the photography for this experiment, a scale of 1:5000 was used and the coverage was obtained both on color and on Ektachrome Infrared film. Additionally, the photography was flown during the autumn when there was a maximum of color differentiation. Vertical coverage was taken and photo-mosaics were prepared. At this scale, individual tree crowns could be seen and each area, whether swamp, deciduous or evergreen, could be accurately delineated. The mosaic in color, along with the analysis (giving number of acres of each type of vegetation), was placed in the engineer's office and was made available to all bidders. Because the mosaic was in color, it was very easy for the bidders, who were untrained photo-interpreters, to visualize and study the whole area at their leisure. The mosaic in Ektachrome infrared, which is a false color film, was used only by D&RT Co. to assist in the analysis. This film is excellent for delineating swamps and drainage patterns [illegible] false color characteristic, is less understandable to non-photo-interpreters.

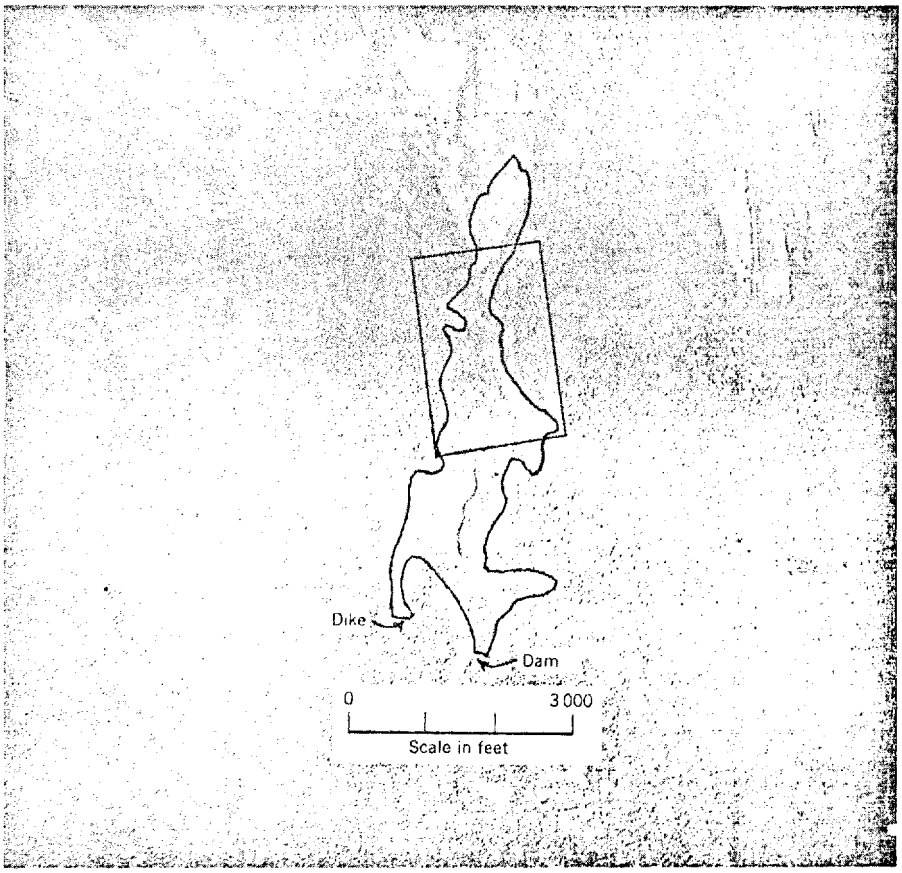


The Cover: Aerial photography, using both color and Ektachrome infrared films, was used to help bidders prepare their bids to clear land which was soon to be flooded as a reservoir filled up behind a new dam. The two photos show more than either shows alone. Lines show limits of the area to be flooded.

The regular color photo (upper) permits identification of five situations: (a) a flat meadow to the left within the boundaries of the flood pool; (b) a river across middle; (c) a tan-grey zone parallel and adjacent to the river on both sides; (d) a zone of evergreens on both sides of the river blending into (e) large areas of deciduous trees, mostly outside the flood pool area. The leaves on these deciduous trees have already changed color owing to the lateness of the fall season.

The Ektachrome Infrared photo shows false colors. Healthy green vegetation appears red or magenta, while unhealthy, dying or dead vegetation appears blue. The high absorption of near-infrared light by even the thinnest layer of water on the ground results in a dark blue-black color on the film. Thus drainage areas and damp soil can be easily delineated.

Spot checks in the field showed that the meadow (a) was swampy and zone (b) was an extensive area of dead trees. This area was inundated by rising waters due to beaver dams constructed during the past 15 years; it is significant that the dead trees in zone (c) had been primarily evergreens, which are sensitive to drainage conditions. The line between the two provinces is clearly delineated on both photos, and delineates the inundated swampy area from the higher, firmer ground.



Analyzing the bidding

The results of this experiment were quite interesting. The mosaic and analysis were available to all contractors. Only two of the contractors studied it in any detail. These were the two lowest bidders. The bids were as follows: $38,210, $39,555, $56,473, $57,375, $68,300, $79,363, $122,000, and $361,500; the authors feel that only the lowest five bidders had serious interest in evaluating the project and obtaining the job.

Detailed discussions were conducted with the two lowest bidders to help determine the value of the large scale photo-mosaic and its analysis. The low bidder, who got the job, felt that the analysis provided to the Palmer Brook Corp. could have saved them $30 to $50 per acre depending upon what original assumptions were made by the contractor concerning the terrain. For example, had this contractor assumed that the entire area was swamp and therefore unable to support the usual tracked equipment he would have charged $30 per acre more, or an additional $4500 for this job. When pressed for a more specific answer concerning costs, he conservatively stated that the analysis saved the Palmer Brook Corp. "at least $10 an acre."

Discussion with the second lowest bidder, whose bid did not differ significantly from that of the lowest bidder, indicated that their intended bid was reduced at least $10,000 by virtue of the analysis provided; this contractor not only used the analysis for delineating the difficult swampy areas, but also for estimating how much timber on the property would be saleable to a local lumber company. He estimated that sale of this timber alone would net him approximately $5000 in addition to his profit from the clearing job.

Value of aerial photos

There are many factors affecting the costs of a land clearing project, some of which have little to do with the conditions of the terrain; good examples of the latter are the seasonal work load of a given contractor and whether or not he really needs the job, and the unbalanced bidding used by contractors to assure sufficient capital at the early stages of a project for financing when, as in this project, more than land clearing is involved. As a result, it is difficult to put an exact figure on what this analysis will save on any particular job or set of bidding [illegible]

Prices per acre for this project were approximately $245 for the low bidder and $260 for the second low bidder. The customary prices for jobs such as this vary between $300 and $400 and in fact, the average cost per acre of the five serious bidders in this project was $350. Comparing this average value with the low bidder's $245 per acre cost suggests that savings of nearly $15,000 may have been realized by the Palmer Brook Corp.; the conservative estimate of the authors, however is that at least $4,500 was actually saved by providing this analysis. For a photo job this size the cost would be approximately $2,500, so that the analysis is clearly economical. The savings, of course, would go up as the size of the job increased.

Spotting potential islands

An unanticipated advantage of this analysis was observed once the land clearing effort began. Since neither the U.S. Geological Survey 7.5 minute series topographic sheet (10 ft contour interval) nor the actual flood pool survey of the periphery indicated otherwise, it was assumed that no island highs existed within the flood pool area. It was observed, however, as clearing progressed that there were, in fact, three small islands within the area. Their elevation was such that unless extensive level profiles were run during the original survey, they could not have been detected from the ground; once found, however, the property owner determined to leave them uncleared, for they would add beauty to the lake site.

The aerial photographs were then reexamined to see if the islands could have been predicted prior to the clearing operation. It was observed that all three islands supported vegetation different from their lower and less well-drained surroundings. This vegetation difference was seen clearly on the Ektachrome Infrared film. As a further check, stereoscopic examination of these large scale photographs was conducted. The islands could be detected in this manner also; it was not possible, however, to see the islands using the standard 1:20,000 photography.

Another value accruing to the contracting agency from the photo-mosaic and analysis is in more clearly defining at the outset of the job the costs and problems likely to be encountered; this information should be useful in obtaining appropriate bank financing for the project. The mosaic itself, owing to its large scale, is likely [illegible] development work in the area.

THE READERS WRITE

Equal Opportunity

TO THE EDITOR: An item in the July issue (page 116) requires correction. The Equal Employment Opportunity Commission is not a "special arm of the Labor Department" but an independent agency, set up under Title VII of the Civil Rights Act of 1964. We are not involved in monitoring the activities of government contractors. That responsibility lies with the Office of Federal Contract Compliance (established by Executive Order) in the U. S. Department of Labor. We have not been instrumental in cancelling or withholding construction contracts, as your story relates; but we have, as you also indicate, been attempting to obtain legislation to strengthen our enforcement powers. Still another error in the story relates to your charge that this Commission has been in direct conflict with the Office of the Comptroller General regarding contract awards which is not the case at all.

GLADYS UHL
Director of Public Affairs
Equal Employment Opportunity Commission
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Airport Terminals

TO THE EDITOR: I very much favor the development of rapid transit lines to connect airports with city centers, and believe the trains should be equipped to handle luggage. In the August issue (page 29) you state that Cleveland is the only U. S. city so equipped; what about Boston? Subway trains go to the end of the airport, and buses from there go to various company terminals.

I much prefer the European to the American airport terminals layouts. In the European terminals, generally speaking, one service handles all departing or arriving passengers regardless of the company with which they are traveling. This permits centralized information, ticket handling and baggage handling, and shortens the distance passengers have to walk. In American airports, on the contrary, the passenger is obliged to walk long distances and there is virtually no effective cooperation between airlines for the benefit of passengers who are trying to make interline arrangements. This observation is based on 20 years of international air travel.

[illegible] M. ASCE
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